Compact Analytical Neutron Interrogation System

Nonintrusive method for chemically identifying bulk materials in the field

LLNL has developed a technique to identify chemical elements using a portable, electrically driven ion-tube accelerator, which can produce pulses of 14-MeV neutrons. The neutrons react with chemical elements, producing gamma radiation. The characteristics of the gamma radiation identify the chemical elements and their relative quantities. The technique is highly penetrating, illuminating 1-m depths in common objects. Our system is field portable, so it can perform in-situ measurements and analysis. The system has wide application as a portable explosives identifier.

APPLICATIONS

- *On-site inspections for nuclear materials*
- *Identification of hazardous materials for site remediation*
- *Identification of mixed waste*
- *Inspection of contraband or drugs*
- *Identification of unexploded ordnance, chemical weapons, and explosives*
- *Process-line monitoring*

Conventional techniques and their limitations

Conventional scattering techniques range from oil-well logging tools that are over 1-1/2 m in length to sources developed for the detection of transuranic waste that are about 24" long. The power supplies and supporting electronics can add hundreds of pounds to the package, limiting the overall portability of the system. Our compact system is approximately 1/10th the volume of conventional systems, with a factor of ten increase in power density.

Portable, electrically driven ion-tube accelerators can offer several advantages over isotopic neutron sources for nondestructive evaluation of materials in closed containers. The higher neutron energy (and higher cross sections) makes more elements available for measurement. The typical source strength is 10^8 neutrons/sec, a factor of 100 greater than available from a 1-μg ^{252}Cf source, which will result in a much shorter counting time for most elements. When the ion tube is shut off, no neutrons are emitted. The ion-tube source is the only neutron-based assay method that truly satisfies an ALARA (as low as reasonably achievable) criterion for personnel exposure.

Fast, reliable source of neutrons

Our two-suitcase, self-contained system is easily transportable to a site. The system is easy to operate remotely from a PC computer. The size and portability make the system extremely flexible. The neutron tube and detection system can be placed up to 100 ft from the control console. Interlocks help ensure safe operation. This remote capability makes possible simple measurements of delayed activity from capture or particle-exchange reactions that lead to short lifetime beta decay. This technique is particularly appropriate to process-line monitoring or field analysis.

Availability: We are seeking industrial collaborators to develop and commercialize the system.

Contact

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